RELIABILITY, QUALITY, AND NDT - KEYS TO SOLDIER SATISFACTION

Hon. Harold L. Brownman
Assistant Secretary of the Army
(Installations and Logistics)

With Introduction
by

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I have been following the ARPA/AFML program now for better than a year and have never been disappointed in the content and spirit of the meetings that have been held. It's truly a credit to Mike Buckley and the supervisors at AFML, to Ed Van Reuth at ARPA, and to the team of people at Rockwell and the support contractors who, with Dr. Thompson, are undertaking this far-looking program. It represents a well structured attack on some major problems in NDT; the results will allow the discipline better application in production and field testing, and this is really the nub of the whole thing. There is a tremendous chasm between the application in the factory and the techniques that are and can be available from the laboratory.

Now, this business of NDE is something in which the Army has great interest. While the Air Force has interest in aircraft and their propulsion systems, the Army has a very wide spectrum of products some of which are procured in enormous quantities -- rather staggering quantities -- about which we have a concern for requirements in quality. We thought it would be most appropriate to get an expression of Army material developments and trends since this project at Rockwell is also supported by DoD through ARPA. It is truly a DoD program. And we've had the support, of course, of Ed Van Reuth and the people at ARPA. We are thus most priviledged this evening to have a speaker from Army Headquarters, the Honorable Harold L. Brownman, Assistant Secretary of the Army for Installations and Logistics, who will speak to us on "Reliability, Quality and Nondestructive Testing - Keys to Soldier Satisfaction."

I'd like to take a minute to tell you some of his background. His current responsibilities for almost two years now as Assistant Secretary of the Army are extensive, and I'll note these in reverse order to that given in his vitae sheet. His duties include small business, family housing, construction, facilities and real property management, installations, planning and programming, industrial mobilization, nonfinancial aspects of the military assistance program, and last but certainly not least -- and really the reason we're here tonight -- material requirements. And that means weaponry and supplies. It means procurement and production; it is management--material management and logistic services -- the support, maintenance, and logistic services to weaponry.

You'll find that his background is tempered with experience in the electronics world. He began with electrical engineering degrees from Polytechnic Institute of Brooklyn; he's had experience at Fairchild Engine and Airplane Corporation, Servomechanisms Incorporated, American Bosch, and Fairchild Camera. He was Director of Systems Engineering at Airborne Instrument Labs. and Vice President of the Garland Division of LTV Electrosystems.

Just prior to his service with the Army, Mr. Brownman spent almost four years with the CIA as head of the Office of Special Projects and as Deputy Director for Management and Services, responsible in these positions for national intelligence surveys, gathering programs, and the solution of management issues.

Now, his technical experience in these prior mentioned positions is very wide indeed. It includes missile guidance, servosystems, computers, data processing, display devices, photographic and radar reconnaissance systems, electronic warfare and communications--a very wide spectrum.

He has been very active in IEEE. He is a member of Sigma Xi, AIAA, and last but not least, the National Association of Old Crows, but I'll say no more on that.

And so, ladies and gentlemen, I have the distinct pleasure of presenting the Honorable Harold L. Brownman, Assistant Secretary of the Army.

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Thank you George Darcy. I must admit that it's rather strange to be here. In fact, I'm not quite sure why I was asked to be the keynote speaker; I'm not sure what a keynote speaker does. I formed one conclusion listening to the earlier comments. ARPA sends money, the Air Force sends money, the Army sends a keynote speaker, Harold Brownman. I suspect that somebody in the Army is trying to get even with me and that's how I got tagged for the chore.

Now, all good speakers start out with a couple of interesting little stories, and in all honesty, I had planned a couple of little stories and anecdotes, but all of them were off color, and seeing we have a mixed audience, I'm just going to have to pass them by tonight.

I have been asked to speak about reliability, quality engineering, quality assurance, and nondestructive testing. The nondestructive testing part has really gotten to me, and I'll address that at the end of the little talk. I get myself quite upset when I visit contractors, upset with myself when I was a contractor. You come in and you get a wiring diagram of the corporation. Here's a reliability organization and here's the quality assurance organization. Here's an R and D group, and here's the production engineering group, and it sort of sounds like everybody is running their own corporation. Being an old-fashioned engineer, I was brought up to believe and understand that you design reliability into the equipment in the first place. Of course, my experience was limited to vacuum tubes and discrete components and none of this sexy stuff of solid state physics and MOS and LSI devices. When you designed a circuit and you looked at the worst case power requirement and current flow and somebody said "you're going to have to deal with this kind of a range of ambient temperature," you derated a resistor. This meant that if it had to dissipate an eighth of a watt, you might decide to put a half watt resistor in there and you provide enough space so that it would fit in and some cooling air around it and maybe a little heat sink and the equipment worked very, very well.

It seems to me, from my own personal experiences, somewhere or another we lost this. You know, we have separate reliability organizations, we have separate quality engineering organizations, and by God they haven't joined the main stream of design and development of weapon systems. I don't know where or why we lost it, but frankly, it's a serious consequence and one that should not be given as the subject of talks, but by God we ought to do something about it.

Now, many people here in the audience are in management positions in their various companies, and I think this is a message that they have to bring back, that reliability is designed into the equipment from the first day, and after the design is complete, it's too late to go ahead and try and achieve reliability.

Now, we do have product improvement programs. Product improvement programs are a very cost effective way, as far as the Department of Defense are concerned and the Army specifically, to improve what we have. Principally, they are for the enhancement and the expansion of equipment capability and really not to re-engineer or re-do a lousy job in the first place. And all too often, it comes across my desk as a request for a million dollars here and ten millions dollars there for product improvement programs which are really to re-engineer a lousy job in the first place, and I think it has got to stop. Enough of a bawling out!

I have been asked to talk about Army requirements. I want to talk about Army requirements. I want to talk about the Army's needs in perhaps a way that you haven't been talked to in a long, long time- or maybe never. Every DOD speaker will come up and tell you, "We've got a budget crunch. Salaries and cost of services go up at anywheres from 5 to 12 percent a year; material costs go up so much and the DOD and the Army budgets stay fixed and where are we going?" We're going no place!

Well, all that's true, and that's a broken record. I want to talk about the Army, which is an all volunteer Army. Congress, as the spokesman of the people of this country, decided to do away with the draft. Well, I'm not going to discuss the merits of whether we should have done away with the draft or not, but the fact is that the young soldier in the field is there because he volunteered. Now, some people say, "Yes, he volunteered because he couldn't get a job in the civilian economy because we had a recession over the last two or three years." That may be, but he still volunteered. His continuing existence in the field doing this job is going to be based upon a voluntary expression on his part.

Now, frankly, you work in industry and you work for companies. If a company didn't give you a decent desk or a decent chair or an opportunity to use a telephone to carry on your normal day-to-day business, you would up and quit and find a company that would. Now, I didn't say you needed a sexy, air-conditioned office, a good secretary or a typewriter or what have you, but there are certain basic items that you need; otherwise, you go look for another job. Well, our young soldier is the same kind of person now, and unless we can give him in the field something that permits him to do his job efficiently, he's going to up and quit.

The other issue, and perhaps you people haven't been close to it, is the publicized-well publicized-Army position of improving the tooth to tail ratio. What this means is we want more people in uniform to be fighters, not lovers, and less people to be in the support and maintenance area. Now, this has got an immediate reflection in terms of the quality, life, and performance of our hardware in the field. Sometimes, I think that what we need in the Army is a one-horse shay. We need a tank

where everything that's perishable or vulnerable fails at one time. We can't stand one item failing one day and the next day another item. You know, it's continually in the maintenance shop. And if you look at those kinds of numbers, you will find that with very little problem, we can have about 30 percent of the Army inventory in what is very affectionately known as maintenance float. In other words, it's in the shop. If you people own two cars, and most families have two cars, you figure out what it would mean to you to have your two cars, in terms of 30 percent of their capability, in the shop at all times. Number one, the frustration of getting the kids to school, dancing lessons, yourself to work, your wife shopping, and all the other chores that you use your cars for, as well as, incidentally, the cost. It doesn't come cheap.

So, the name of the game is to clean out the maintenance facilities, keep the equipment out of the maintenance shops, and get going with it.

Now, we have perhaps a unique problem in the Army, compared to the other services. We run arsenals and depots. Arsenals and depots are part of the Army backbone for mobilization, but they are also for overhaul and maintaining our equipment. We have some depots overseas; we have most of them here in the United States. Incidentally, if you think it's cheap to transport a tank from Europe back to Anniston, Alabama, for overhaul, you try and pay the freight bill just one time. It's not easy. It's very frustrating to have a tank go into the Anniston Army Depot and be overhauled and go down the road 50 miles and have the alternator quit.

Well, you know, why didn't you put a new alternator in the damn thing in the first place? The answer is we can't afford it. Well, what do you mean you can't afford it? Well, we have to put out, and this is a standard answer, we have to put out what's known as DMWR. If you're not used to the alphabet soup of the Army in Washington, a DMWR is a Depot Maintenance Work Requirement. It sort of says a tank goes in for overhaul and you do certain things to it; you look at certain of the components; you inspect, repair and replace as necessary. And so somebody looked at the alternator and it looked perfectly fine; it spun, you ran it at the rated speed and the voltage was right and maybe you put a dummy load on it, and it even carried the dummy load, but 50 miles downstream it crapped out.

You know, before we had jets, for those who travelled in airplanes, we had reciprocating engines. The pilot used to go to the beginning of the runway and he would stop there and he'd rev his engines. What was he doing? He was doing a mag check. What he was really doing was stress testing. He was developing a level of confidence that those engines would continue to put out the power that they were supposed to during the period of critical flight, namely, takeoff. We don't do that with our jet engines anymore, although we have what's known as BITE or built-in test equipment, and presumably the little red lights and the dials and the knobs and what have you tell the pilot that the jet engines are working and they're going to supply the power on takeoff.

Now, I felt a lot more comfortable when they did the mag check, frankly. You know, I was able to see something, hear something. It was alive.

Well, one of the reasons why I'm being punished by giving the keynote speech here is somebody in the Army, I think, got upset with me and I said, "Goddamn it, why can't we have stress testing with equipment coming out of our depots? Why can't I get a howitzer that's been rebuilt and overhauled and tested so that I know it's going to last a certain period of time under normal usage?" Well, we're trying. I'll go into some details on that, and I'll go into a story that perhaps you've heard. It's been well publicized in the papers and press for about three years.

About three years ago or so, the Army found itself woefully in need of tanks. Its inventory was somewhat less than 50 percent of our authorized levels. Now, some of this was due to the Army's fault; some of it was due to circumstances beyond our control. We got involved in a series of programs to increase the inventory of combat-worthy tanks. And if you go to somebody in the Army today, a combat-worthy tank is the following kind of tank; it has a diesel engine; it has a 105 millimeter gun; and it's able to carry a minimum of 47 rounds of ammo. That's a combat-worthy tank. We were able to develop the industrial base to produce tanks known as an M60-A1 which had those characteristics. We also had, oh, something less than 5,000 rusty hulks known as M48-A1s and M48-A3 tanks which were at least 25 years old.

Well, in a desperate desire to build up this inventory, we said, "Hey, you know, our short supply is castings for M60 tanks. We have all these castings sitting around in various dump yards and PDO places rusting away, why can't we use those castings in some way?" So, we came across the concept of modifying the castings to install a diesel engine, put a 105 millimeter gun in it and carry 47 rounds of ammunition. We were able to do that very cheaply and very quickly and we thought, "Well, we have a combat-ready tank."

Well, some wise heads in the Army said, "Well, what kind of a tank have you got here?"

"Well, it's combat-worthy. It has all the characteristics you told me . Yeah, but is it as good as the M60-A1?"

I said, "Gee, I don't know." "I used all the M60-A1 parts; I used the engine, the transmission; I used the same breech block; I used the same gun tube; I even used the same little racks that held the ammo in the tanks. It's got to be, I even used the same track and the same suspension."

Well, the Army people, being people who work on the land and the ground, probably all come from Missouri, and they wouldn't believe that it was a combat-ready tank. So, after a great deal of fuss and fury and negotiations, we said, "All right, we'll take five tanks now known with the official name of M48-A5--what happened to M48-A4, I don't know, but it's somewheres--and we'll arbitrarily choose five of them and we'll take them over to a place called the Yuma Proving Grounds.

Now, the Yuma Proving Ground, if you want to envision it, is rough terrain, somewhat approximating the moon, and about a hundred degrees Fahrenheit hotter than the surface of the moon. This was considered the proper place to test our beloved new combat-ready tanks.

We ran those tanks with some soldiers who were experienced tanks crews up from, I believe, Fort Carson, and they were run by a very nice young lieutenant whose name was Mudd. So help me! From Buffalo, New York, a very bright young lad, and you know, he became the most popular lieutenant in the Pentagon as far as the Army was concerned for approximately three months.

After that he disappeared, not in defeat, but back to something that had less visibility, because it did worry his nerves to have the Assistant Secretary of the Army come out and visit him every six weeks to see how things were going on.

Some interesting statistics came out of that test. The Yuma test, you know, was really a milestone. It turned out that those five tanks had a mean miles between failure of 85 miles. Now, don't laugh, don't laugh. A tank in combat will travel approximately 50 miles a day. So, you know, I figured "Hell, that's not too bad. It's got 300 miles of fuel in its gas tank, so it doesn't have to be topped off too much." You've got a lot of ammo in the ammo racks, and you can fire a lot of rounds without being resupplied, and what we have to do is just take four guys that are in the crew and have them maintain the goddamn tanks. Every night!

That gets kind of tough. If you're fighting all day, it's kind of tough to maintain and repair the tank at night. And besides, those smart heads in the Army told me, "You know, that's a loser because the next war, the next ground battle is going to be fought at night." So, we're developing all these night sights and all these night fighting weapons for that."

And so, being a cilivan at heart, I said, "Well, we'll repair the tanks during the day." But that was no good.

But seriously, in looking at the data that came out and yielded that 85 miles, I detected that an awful lot of the subsystems that we borrowed, literally, from the production lines of the M50-A1 like the engine, the transmission, the tracks, the suspensions, the ammo racks and all that--the ammo racks didn't fail--that a lot of those things were failing. And I said, "Hey, why don't we segregate those failures into two piles; those failures in this pile that were M60 unique, and these that were M48-A5 unique. Maybe we'll have a difference.

Well, it really didn't pay off too much. And after a great deal of blood, sweat and tears, we decided that the M48-A5 was a combat-worthy tank, and that we would distribute it in accordance with a previously organized plan to the Army--well, not to the active Army-to the National Guard and reserve units.

But don't laugh. It's kind of important. There was a case made. You know, we'll give them valuable training on maintaining diesel engines, transmission, all those things that they will have in the M60.

Of course, in the course of this conversation, being a naive civilian, I said, "Hey, by the way, what's the mean miles between failure in M60-A1, that grand and glorious device that you're producing out of Detroit at so much a month?"

Well, somebody said, I thought it was 275 miles," and then somebody said, "No, it was 120 miles," and I got enough different answers that I was convinced that really nobody knew anything in terms of it.

So, after a lot of blood, sweat and tears, we ran, or we organized and planned and are running, today a test called BART. Now, I know this is Monterey and before anybody laughs, it's not intended to be a duplicate of BART in San Francisco. Believe me! It stands for Baseline Armor Reliability Test. We did what I consider a very interesting kind of experiment. We took five tanks, M60-A1, brand spanking new, arbitrarily chosen off the production line in Detroit. We took five M60-A1 tanks that had been turned into the Army Depot system for major overhaul--and I'll get to the characteristics of that major overhaul, we're not through with that yet--and we'll take five of my beloved M48-A5 tanks and we're going to put them down at Fort Hood, and we're going to test them simultaneously for three phases of 750 miles each, and we're going to have inspectors looking for failures and maintenance problems and see how the tanks work out.

It turns out all three tanks are about the same in terms of mean miles between failures. It also turns out that we have about tripled the mean miles between failure of the M48-A5 tanks as a result of the BART test. You know, a little thing like the change of the material that carries the gas from the gas tank to whatever the diesel engines use to distribute fuel around. It no longer snaps due to the vibration because we have a thicker material and a different material. We are learning from this test, and we hope to learn more. I think it really demonstrates in a serious way that the Army is fully cognizant and recognizes its problems in terms of reliability and in terms of deciding to give the man in the field an even break.

He needs more than an even break. If you look at the number of tanks that the Soviet Union and the Warsaw Pact nations can field, you will find that their inventories are about four times what ours is. I can only hope and pray that their maintenance float is ten times our's. If they're in the field, we're going to get clobbered, literally clobbered. By the way, don't think that their tanks are a poor quality, or less sophisticated than ours. They are every bit as good, every bit as sophisticated. Don't believe this stuff that you will read in the papers and the editorial pages about how the Russian soldier can't read a map and he's illiterate and he's stupid. Not so. He's pretty smart. Just as smart as our boys are. And, you know, there is no break on that battle field. That stuff has got to be there and it's got to work.

Incidentally, out of the BART test came another kind of interesting issue. The Army flies a lot of helicopters and we have the greatest, most sophisticated spectrum analysis capability for oil from engines, crankcases, and transmissions down in Corpus Christi, Texas, at the Corpus Christi Army Depot. Most people think that's a Navy base, but no , it isn't. It's really Army. The Navy is sort of a tenant of ours there. We find that we can determine that a helicopter engine is about to fail by looking at an oil sample of the engine or of the transmission.

Well, we finally got the armor people around to saying, "For the BART test we're going to take oil samples from those engines and from those transmissions." I think--I may be prejudging it--but I think that we're about to make a breakthrough that will permit us to say that an engine is going to fail in the next, perhaps 50 or 100 miles by just analyzing the oil sample with spectrum analysis.

The last part of the problem is if somebody can get me a little oil spectrum analyzer about the size of this pack of cigarettes that I could put in between the ammo in those ammo racks so that every day or every hour or every night the driver goes over and he drops a couple of drops of oil, just like you do with your swimming pool to determine if you have enough chlorine in the pool, and he looks at it and it's a red light or a color--and I'm colorblind, so I have no appreciation of these things--to tell him that, "Hey, that engine is about to crap out. Don't count on this tank for next day's battle," or, "Get back to some sort of a maintenance area and have it pulled."

Incidentally, it only takes about 15 or 20 minutes for an experienced crew to pull an engine and transmission and replace it with a new one. That's part of the RAM activity that we do.

Okay. I've said some bad things about the Army. I could have said some things that were even worse, but I really don't want to scare you and I don't want to embarrass some of the people in the audience. We had a pre-dinner session on one or two little problems. We are trying to right what I consider about 201 years of ills and head in the sand attitude. The Army is 201 years old; we're older than the nation, and so we are doing things. For example, in FY-77 the materials testing technology budget is about $4 million of which $3 million is devoted to nondestructive testing, NDT. I'm confused as to the difference between NDT and NDE, but we'll get to that later.

By the way, of the $3 million, about $1 million is going to be devoted to the automation of nondestructive testing, looking for critical defects. That's, by the way, a high payoff area, let's not kid ourselves. You take that 105 millimeter gun on a tank and you fill up all those tanks with those rounds, it turns out that we produce 105 millimeter ammo at anywhere from 20,000 to 50,000 rounds a month, and nondestructive testing of those rounds has got to be a very serious matter.

First of all, the warlords--those are the people who know how to fight--they say, and the Israelis back it up with their experience in 1973 that in order to win a ground battle, a tank must have what is known as the first round kill. Now that goddamn shell has got to work, and don't let anybody kid you. If it doesn't work, your tank crew is finished, because somebody else is going to get that first round kill.

It's pretty easy to do with all the sophisticated fire control and gunsights and infrared and night fighting sights. You just can't hardly fool a man, even with smoke.

I find it kind of embarrassing to stand in front of you and say, "Hey, the Army had --I don't know--$18 billion a year budget, which includes everything: pay of soliders, shipping of tanks back from Europe to be overhauled, and what have you, and all we can find is $4 million for materials testing technology."

My only excuse for that is that by God it falls under the aegis of the Assistant Secretary for R and D and not for I and L. So, I'm not responsible for it. Now, maybe I wasn't invited here as punishment, maybe this is a backhanded way of saying, "Hey, could you lend us a little money?" My reaction is that, "Yes, I think we could."

Now, I talked about our budget, let me talk a little bit about the things that we are attempting to do. We're attempting to have automated radiography to inspect explosives. You know, that's nondestructive testing right off the bat. We're spending money in optical laster techniques for service defects.

By the way, my ignorance in this field of what the Army is doing, because it really doesn't come under me, is proven because I have to read these from cards. It's no joke; it's serious.

We're using ultrasonic devices to examine billets and bar stock and castings for integrity in terms of locating blow holes, impurities, and things of that sort. When you think of tanks and think of 105 millimeter shells hitting tanks, weaknesses in tanks are kind of important, and to find them is equally important in terms of the survivability of the crew.

I find the next one absolutely fascinating. We're going to use a scanning densiometer for automated handling of data of spectrographic plates and films which are made during chemical analysis of engine oils and steels. You know, that's in the technology program. I want to tell you a little secret. You heard a tad of my resume background. I have been involved in reconnaissance and intelligence business for a hell of a long time. You know, we used scanning densitometers to locate targets on reconnaissance film when Hector was a pup, and the Army today is spending technology money to use this in its testing and reliability business. I don't understand. What happened to that technology? Did it go down the drain? Did somebody lose it? Or do we have to re-invent it? I told you I wasn't going to be pleasant to the Army people.

The next one boggles my mind. We're going to use a holographic fringe quantification system for use in interpreting holographs. I have a feeling that I read some material on that awhile back, and I think that's also a do-over, and it's probably getting ourselves into trouble.

Okay. Enough for the theory, and I call that theory. I did talk about the fact that we are concerned at Corpus Christi about crankcases and transmission oils from helicopters and prediction of failures and life extension.

We overhaul helicopters at Corpus Christi Army Depot, but we also have a very interesting activity there, which is very closely tied with helicopters, and that is, we have a complete bearing facility. We do have techniques which are in hand; using magnetic leakage field techniques and other techniques to determine what the stress patterns are on components of bearings. Also, to identify the infant bearing failures. These are failures of bearings in helicopter engines that fail before or occur before the helicopter and engine is due to go in for overhaul. In other words, you overhaul an engine, a helicopter and you say, "Okay, fellow, you've got 250 hours of flying time. When you get that, come back and see me and I'll overhaul it again." Which is great, if that's the right number. But then, the bearing fails after 75 hours and all of a sudden he's back for an overhaul because he has got a bearing failure and you have got to redo the whole engine and it costs us--I guess it adds about 25 percent to Corpus Christi's budget just to keep track of the infant failures on bearings. So, we have, not only sophisticated techniques in evaluating bearings, but we also have a rather elegant--and being a rather cynical chap, I consider it elegant--bearing reclamation facility whereby we are reclaiming these big, expensive bearings that cost a thousand, two thousand dollars a shot, for very little money.

Now, the nondestructive testing people in the Army do many things, and I do want to add a personal note about Mr. Paul Vogel, who is very heavily involved in our nondestructive testing program, and he, in his program, had been using some infrared mapping equipment as part of a research project.

Well, looking for additional challenges besides his job, it turns out that Paul Vogel drives around Army installations at night, preferably in the wintertime when the temperature is below the freezing level in a 1969 Cadillac which reportedly has 236,000 miles on its odometer. This is not non-destructive testing. He's required to use the Cadillac because of the equipment he hauls around.

Now, what he does is take this infrared mapping equipment and maps the heat losses from buildings in the Army facilities as part of the Army Energy conservation program.

Now, maybe that's also nondestructive testing. It's kind of an interesting application and perhaps it's a little vignette that says, "All our people aren't that bad; they're pretty smart people and they know what they're doing." I'd like to develop that kind of confidence, and I have. I have been cynical perhaps a bit, but that's to prove a point, and I don't think the Army is the worst there is. I think maybe there are some other people around who might not be able to face up to their problems in an honest way.

Okay. Back to being a keynote speaker. I think we have to provide you with a challenge. I can't hope to debate and discuss sophisticated physics and mathematics with you on a toe-to-toe basis, because I'm sort of an old, worn out engineer, and I really haven't kept up with the technology all that much. But let me refresh your memories. It wasn't more than a couple, three or four years ago that the automobile industry recognized they had an obligation to the consumer and out of that obligation came warranties of 50,000 miles and five years; 10,000 miles and two years; or 10,000 miles and 12 months, and we warranty certain major parts of your automobile.

Now, some of that initiative has been dissipated and lost because of the recession and depressions and other pressures that have been put on the automobile industry, and I think they've had other fish to fry. But it's kind of interesting. The automobile industry can go ahead and provide those kinds of guarantees and warranties to their customer, and our soldier in the field is our customer. Why can't we provide the same kind of guarantees and warranties to him?

Now, you say, "Well, maybe we do." Well, not so; not so. Let me give you some numbers that will boggle your mind.

A tank is considered to have a useful life of 30 years. That's not bad. Your tin Lizzie at home -if you get 10 years out of it, you're probably doing all right. Well, not quite the same. It's sort of apples to oranges.

In peacetime, for training and other activities, a tank averages about 1200 miles a year. That's 36,000 miles of tank life. Depending upon the location of the tank, if it's here in the continental limits of the United States, the number is 6,000 miles; if it's overseas, the number if 5,000 miles. When it reaches that mileage it goes back to an Army Depot for a major overhaul. When I say "major overhaul," it is disassembled and all the paint is removed down to bare metal. Every subassembly, every black box is inspected, repaired, replaced, reassembled and given a little cursory test and, bing, off it goes.

Well, the argument is,a tank takes a hell of a lot of beating compared to your car. You know, if I had a car like that,I'd junk it. I just couldn't afford to keep it. Well, yeah, a tank does take a hell of a lot of beating compared to my car, but you know what? I don't know what you pay for a car nowadays, I haven't bought one in a couple of years. I probably can't afford one, but let's assume that an automobile for family use runs $10,000. Do you know what a tank costs? Fifty times that! $500,000 for a tank. Well, I wonder if we beat it around 50 times as much as my teenage sons beat around my family car, but I'll tell you, that tank isn't performing anywhere near what the automobile industry is providing me. I think there's got to be something wrong.

Now, I listened to a few of the preliminary remarks this evening. We had some exciting discussions at dinner and prior to dinner, and you know, about the physicist really getting into this thing and nondestructive testing and evaluation is multidisciplinary and by God, there are physicists and mathematicians all over the place. Well, god-

damn it, let's get it out of the laboratory and out of the cloistered halls of theory, and let's get it into the field. Let's get it into the depot where it belongs!

The program that was discussed is two years old. I'd like to see a practical result. I'm not a young man; I haven't got much more to live. Please help me!

Now, I have another problem. I was given a speech. You know, when the Assistant Secretary gets a request to speak, he doesn't really look at the subject or why, he looks at the location. Monterey, California, obviously is a nondestructive environment, and I have to compliment everybody on the choice. So, it looked like this was a fun thing to do, and then as time went by I spoke to one of my execs and I said, "Hey, we've got to do something about that speech in Monterey. Why don't you get some bright fellow to write a speech that's appropriate for the location and the people and the subject at hand." I got a speech. It's sitting back there in my room. It's about this thick. I didn't use it really, because I thought it kind of missed the point, but it just added to my confusion to no end. Nondestructive testing- you know if I examine that and try to figure out "what the hell does it mean?" it tells me what it isn't, but it doesn't tell me what it is.

Well, I'm not the smartest guy in the world, believe me, but I sort of divined out the other night on the airplane that maybe what people mean by nondestructive testing is a confidence building test. Huh? I don't want to change your nomenclature, but just think about these things, do something about them. Maybe even more than a confidence building test. Maybe it's a life expectancy test. You know, that's not bad.

As a matter of fact, if I look at us as people--the good book says, and I don't know why it says it, that once a year I've got to have an annual physical. And after going through all the treadmills and all the poking and what have you, the doctor sits down with me and says, "Well, Harold, old boy, I think you're good for another year." That's a life expectancy test. Isn't that what we're looking for?

I really would like to take an APC or a howitzer or a tank or a truck or a jeep and I'd like to be able to put it into something that simulates a carwash--everybody knows what that is--and when it comes out the other end, there's a tag that says, "Good for 750 more miles." That's the challenge that the Army has, and that's the challenge that I think I have to lay on you people.

You know, you don't have many chances in this life. That sounds like an ad for Miller's beer, but I think in all seriousness, you don't have many chances to do this kind of a job, and if you're not going to take it out of the laboratory, if you're not going to provide for an impact on today's world today, we might as well forget it.

Thank you.

DISCUSSION

MR. JOSEPH JOHN (IFT Corporation, San Diego): This has got to do with the topic of liability. Don Thompson, in his opening remarks, identified NDE as being related to the concept of liability in the commercial world. I'm aware of two court decisions in which the Government has been found to be liable for products, particularly with respect to 105 millimeter shells. Would you care to speculate if that is going to be a continuing process where the Government is going to be found liable for the product?

MR. BROWNMAN: I suspect so, but let me tell you something, if you don't know it already. The greatest game in the country is to sue the Government, no matter what. So, to be liable for performance of equipment, yeah, I guess we can be liable, and I think contractors can be liable.

Fair enough?

DR. ELLIS FOSTER (Institute for Defense Analysis): What is the time between breakdowns in World War II tanks?

MR. BROWNMAN: We don't have those numbers. You've got to be kidding. We didn't worry about that. We were too busy fighting, really. There are no statistics. In fact, you raise an interesting point, and that is that the Army seems to be totally devoid of statistical data, real live statistical data, not simulated stuff from a mickey mouse computer where somebody can change the ground rules on you so you don't really know what's going on. I'm talking about real live statistical data. It's nonexistent.

DR. GEORGE MAYER (Army Research Office): First of all, the $4 million that you mentioned in MTT will have a bit of supplement from $200 million additional in a very large MT program, which is manufacturing technology, part of which will be devoted to things like inspectability. The other thing that we really haven't talked about is the human factor in inspection, and I call your attention to things like the sinking of the submarine THRESHER a few years back. Well, we had quite adequate inspection techniques, but these were human failures, and I think that with some of these new techniques that are automated, these human failures will be circumvented. But the human element is still going to be a very major element in this product reliability business. And you have to consider ways of motivating people to make them more responsible and knowledgeable about what they're doing and to become conscientious in their everyday jobs.

MR. BROWNMAN: Well, you're right. Let me address that second point, which I think is interesting, and the reason why I'm glad you asked it is it does identify initiative that I am very, very familiar with, because somebody suggested it and I hopped on the bandwagon. I wish it was mine, and we are doing it, and maybe you are aware of it. We found out in a moment of frustration in building up our inventory of tanks that we were getting a lot of M60-A1 tanks, brand new tanks, brand spanking new tanks out of Detroit Army tank plant, which were heaps of garbage, deficiencies all over the place, and we hadn't had a chance to put a soldier in it to louse it up yet. So, one bright general who is now retired, unfortunately, but he's still bright and deserves the credit, by the name of Joe Pieklik, who was then Commanding General of the Tank Army Automotive Command, did a little analysis--not a study. He didn't study, he went out and analyzed what was going on, and it turned out that about 90 percent of the people who were inspecting tanks, both Chrysler employees and U.S. Government employees, didn't know what the hell they were inspecting.

So, the first thing he instituted was a training program and a method whereby he certified inspectors so they really understood what they were inspecting. If a guy was certified to inspect engines, he wasn't permitted to inspect fire control unless he was specifically certified on that piece of equipment.

Then he instituted a deficiency advertisement reporting system on the tank line using the concept of peer pressure where certain groups at certain work stations were competing against others in terms of the number of deficiencies, and that worked out very well.

Then he went further and he looked at jigs and fixtures in the Army tank plant, which, by the way, has been producing these things for 25, 30 years, something like that, and he found out that they were either in poor shape or nonexistent.

For example, certain nuts or bolts had to be torqued down to a certain torque specification, and there were not torque wrenches on the line. It's not funny.

So, he gave them the torque wrenches and then the mechanics didn't know how to use them. I've gone into plants and I've looked at torque wrenches on the production line and found that they were calibrated 17 years ago.

So, you're right. There is an awful lot of that. Incidentally, you walk into depots and arsenals, and you will find alignment jigs and fixtures not so tapped and you will find that nobody ever checked them to see if they ever got out of alignment themselves for years and years and years. Sometimes they use jigs and fixtures as stepping stools, you know, to get up on the top bin over there, and God knows what they do to the calibration on it. So, the inspection process is a very important one.

Now, there are ladies here, so I'll temper the next one. Chrysler, who runs the Detroit Army tank plant with their people and has been the contractor for many years and is very comfortable in that role, and it's a profit-making venture for them, had a session with me once right after we uncovered all these problems with tanks and the quality of tanks coming out of Detroit, and I said to one of the key executives, "Hey, O.J" --Ollie, his name was. Not O. J. Simpson, Ollie White-- I said, "Hey, Ollie, last night before I went to sleep I couldn't fall asleep because things were troubling me. So I needed a diversion, so I invented a new game and I wonder if you'd play with me." He says, "Well, what is it?" "Well, I guess I'll call it 'You Bet Your Life'" -- to him I used another word, but "You Bet Your Life." I said, "How would you like to make a deal with me on the next contract, for every tank that has five defects or more out of this line, you give me $1,000 of your fee back." Incidentally, they make about $16,000 worth of fee in the course of a tank. You know what? He refused to do it. That tells you the quality of people that are involved in these things.

Also--I'll carry on, I have a couple of points here to make--it turns out that if people on the production line in Detroit goof up--and you can identify now because of this autotrail who goofed up and put the wrong part with the right part and that kind of thing -and they're all unionized, I asked Chrysler, I said, "Do you think your union would stand for a man who has made three errors, three assembly errors in one week to be sent back to a training program for two weeks, at the salary of a trainee?" The answer was, "Unh-uh, no way."

The last item about quality doesn't involve tanks. I am involved in other things besides tanks. I went out to a Army airbase in Stuart, Florida. There was a Grumman facility on that airfield, and there is a Grumman airplane known as the Mohawk, and the Army has a little reconnaissance program in which we install various modular equipment in Mohawks to do reconnaissance chores that would be necessary to the Army. There were some things of issue in the program and that's why I visited the place, and they went through a big rain dance about how we are going to get you in this Mohawk and we're going to fly the infrared and the side-looking radar and we're going to show you the readout and the air-to-ground link and how it works.

This was all very interesting to me because reconnaissance and that sort of thing has been sort of a second hobby of living. But catastrophy befell that day and the infrared equipment wasn't working. It had a bad bearing. Of course, it's just a scanner-type device and I said, "Gee, how many flying hours does that piece of equipment have that it's worn out at this point? The guy looks it up in his records and he says, "Well, we just got that from the depot last week and we put it in the bonded warehouse waiting for your arrival so we could show you how well it works." It was, incidentally, overhauled at the Sacramento Army Depto.

Well, after a little bit of pushing and shoving, it turned out that the great guy who inspected it in the Sacramento Army Depot didn't know what the hell he was inspecting, and so he really never did inspect it, and it was just a piece of garbage.

Okay, next question. That was a long answer to not even a question, but a couple of statements.

You had one?

PROF. GORDON KINO (Stanford University): Yes. I was wondering if there had been any examination of whether there was a tendency to make things too sophisticated that they can never work?

MR. BROWNMAN: I think that's fair and there is an aspect of that. You know, we like to enjoy the elegant sophisticated things, and we play with it and play with it and play with it and it never gets to real life, and I think there is a facet of this. We do reliability studies and analyses and very sophisticated calculations and we bring in high powered computers and we come out with printouts that nobody reads, and certainly nothing gets to the field. You're right.

DR. ROBB THOMSON (National Bureau of Standards): Just a comment on that vignette you mentioned. If the Army learns to use this oil spectrum analysis technique for their new diesel you may be interested to know that this technique was invented back in the 30's by the railroads for guess what? the diesel engines.

MR. BROWNMAN: Yes, that doesn't shock me at all.

CAPT. JIM ANDERSON (Naval Research, Pasadena): I liked your car wash analog and that's something that all the services need for their equipment. But what we need that to do is not to give us a tag saying the equipment is good for so many miles or years but to tell us what to do so it will be good. What that's going to tell us on some of those tanks that come through is that the paint is okay, don't strip it and don't repaint it, but you better replace the number 2 diode in the alternator because that's about to fail.

MR. BROWNMAN: I think there's something to that. By the way, let me take issue with something you said. I think the Army has got a problem that is not shared by the Air Force and the Navy. The Navy carries it's maintenance facility on its back. You go to those capital ships, even destroyers and they've got machine shops and they've got facilities and they're right there, right Johnny-on-the-spot.

The Air Force traditionally flies out of a well-instrumented, well-organized airfield with lots of maintenance facilities and they fly back to the same one or to an equivalent one. But that Army tank, that Army APC and that Army howitzer, they never know where they're going to end up that night when they're going to have their eight hours of rest, and they don't know what maintenance facilities they're going to have. Only what tools and jigs and fixtures and a little know-how that the fighting crew-emphasis on the word "fighting crew" - knows about their vehicle, that's their maintenance facility, and boy, that's vastly different than what the Air Force or the Navy live with. Very different.

PROF. JOHN TIEN (Columbia University): One of the most important points you made, of course, is to shorten the time constant between the theory and getting something into the field. Now, if you look at statistics, we're not very good at doing this unless there is a very strong motivation like a war or something. Do you have anything concrete to suggest on how we can improve on this lacking of ours, any incentive, perhaps, you have in your back pocket?

MR. BROWNMAN: You know, John, you've just given me an oportunity to be the hero of the symposium, but unfortunately, I'll have to decline. Because if I had such a scheme or thought or technique, I probably would patent it and end up as a rich man rather than a worn out, old engineer.

I don't know the answer to it, and that's just the tip of the iceberg. The Army's tank program XM-1 has got some stalls due to NATO politics and Congress and what have you, but let's ignore that facet for a minute, and I don't think it's appropriate to talk about. I don't think you people would be interested anyway. But you look at the XM-1 tank, and it's a good example. We started that about four years ago, and the plan was that it would be in the Army inventory. It has been a few years from concept to operational capability of something known as a tank, which we have been building for, what, 50 years, of that generic type? We can't even get a tank into the field in a

hurry! We're worse than the traffic engineers who build roads. The big cry is the day they cut the ribbon on the freeway, the super-highway, it's overcrowded. Well, the day we give the man in the field the weapon, it's outdated. I don't know the answer to it; it goes beyond me. But how do you get the theory, how do you get the concept into the field, gee, if I knew that I'd tell you, but I don't.

DR. ROMAN WASILEWSKI (National Science Foundation): Just a quicky on some statistics. In the last year of the war, the operative actual lifetime mileage of a Sherman tank in our unit was 430 miles. You said 30 years is lifetime for a desirable tank. The two are somewhat disparate.

MR. BROWNMAN: I'm surprised. The Sherman tank?

DR. WASILEWSKI: Yes.

MR. BROWNMAN: That had a gasoline engine?

DR. WASILEWSKI: We had a selection from diesels to gasoline, five different types per each squadron--

MR. BROWNMAN: I'm frankly amazed. We've gone backwards.

MR. JACK NICHOLAS (Navy): I don't know the answer to John Tien's question either, but I think part of it has to do with getting the people who are going to use the test instrumentation or technique involved in its development very early in the stage of its development. What I have been finding is that I come across very interesting techniques which can be used in the field by one Ph.D. and three people with Masters Degrees, which ultimately is going to be used by somebody who has a high school education if you're lucky and who has to apply a great deal of subjectivity to the interpretation of the results that he's getting out of the instrument. When you can see objectivity, what the end result of the test is, you're much further along towards the solution of the problem of application of a nondestructive examination technique or instrument in the field.

MR. BROWNMAN: That's true. User involvement early on is certainly valuable and can shorten the concept of field time of test equipment or anything. Only one word of caution. The user quite often vacillates. First of all, the planned turbulence in the service means the man in uniform, who represents and speaks for the user in the field, every two years changes, and so you've got somebody with a new idea coming in.

Also, the user tends to want more than he should want, because everything has got to be gold-plated, got to be the latest, newest bauble, and the latest and newest technology, and some of that motivation is good, but I think you've got to be very careful that he doesn't put you into a situation where you can never climb out of it, but your point is well taken.

DR. DON THOMPSON: We have time for one more question.

DR. PETE CANNON (Rockwell International, Science Center): Mr. Secretary, isn't part of the answer to the Columbia University charge that we in industry should not take on scientists and engineers who don't know how things work and don't care, and that the universities shouldn't graduate scientists and engineers who don't know how things work and don't care?

MR. BROWNMAN: Yes, I think so, but that's a subject for another night. Here's a rebuttal. I think we're going to hold the rebuttal until we have the mixer or hospitality hour. I can hardly wait for that.

Thank you.

DR. DON THOMPSON. Thank you.